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Lehigh University Cognitive Science Program

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This newsletter is published twice each year, in spring and fall issues, by the Cognitive Science Program at Lehigh University. Its purpose is to inform faculty and students about the interdisciplinary and growing field of cognitive science and to report the activities of Lehigh's Program.

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The Editorial Staff welcomes readers' comments and *solicits materials* dealing with cognitive science. We are especially pleased to consider course syllabi, short essays, brief descriptions of scholarship and research in progress, extended abstracts of doctoral dissertations, book reviews, and original art work (e.g., cartoons, line-drawings, computer-generated images).

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## Towards a Cognitive Science of the Embodied Mind

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The sciences of the mind are on the cusp of a fundamental revolution. There is no single driving force behind this revolution—instead, it is the product of multiple converging influences coming from real-world robotics, systems-level neuroscience, cognitive psychology, evolutionary theory, Artificial Intelligence, and philosophical analysis. The point at which these influences converge is the new vision of mind as *in essence* a controller of embodied and environmentally-embedded action. Mind is an organ for orchestrating real-time responses to a real world. What's so radical about that?

What's radical is the outright rejection of a venerable tradition of *intellectualizing* the mind. Descartes's outright separation of mind and matter was of course, long since rejected. But the vestigial image lingered on. It lingered on in the separation of perception from cognition, the practice of computer modelling of pure, disembodied processes of planning and reasoning, the methodology of single cell recordings from the neurons of anesthetized animals, and the separation between so-called central systems and peripheral input devices. It lingered too in a chronic inattention to the problem-solving shortcuts presented by bodily motions and environmental interventions and in the lack of a developed framework for understanding adaptive couplings which crisscross the animal/environment boundary and which involve properties emergent from the collective action of several individuals or of several neuronal populations within an individual. Mind, you might also have believed, was in essence an organ for reasoning in the dark! But over the last five years or so, there is encouraging evidence of the dawn.

One major player in these events has been the explosion of work on Artificial Neural Networks. Such networks amounted to an existence proof of the possibility of adaptive intelligent behavior without reliance on explicitly formulated rules or language-like data-structures. Moreover, the networks integrated representation and action in a very direct manner: knowledge became encoded in a form dictated by its use in a particular type of problem solving. But the Neural Networks revolution, the subject of my two MIT Press books (Clark 1989, 1993), was incomplete. It was incomplete because it was burdened with much of the unnecessary baggage of the previous, disembodied, symbol-crunching approach to understanding cognition. Mind was still treated as an essentially timeless locus of abstract problem-solving capacities.

Enter the cockroach. Less cryptically, enter a surge of interest (in the late 80's, early 90's) in what became known as Autonomous Agent research (see, for example, essays in Beer, Ritzmann, and McKenna 1993). This research aimed to

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*This issue features articles by Lehigh's Cognitive Science Keynote Speakers of 1995 (Andy Clark) and 1994 (Myrna Schwartz).*

## Embodied Mind (cont.)

model and understand the adaptive success of single, complete, embodied systems: insects which walk and seek food, the cockroach's amazingly sophisticated mechanisms for detecting and evading attackers, robots which learn to swing from branch to branch using real mechanical arms, etc., etc. Many of these models exploit Artificial Neural Networks as control systems. But the constraints on success are now very different. What we now confront is nothing less than massive re-orientation of research energy and funding towards the study of simple-seeming, real-world, real-time problem solving. This reorientation highlights the delicate interplay between mind, body, and environment. At its most radical, it questions the value of these distinctions themselves. All this has major and somewhat heretical implications for the very idea of a science of the mind. It is one part of a full-scale rethinking of some of our most fundamental ideas concerning mind and reason.

This full-scale re-thinking draws, in addition, on new research on language, on infant development, and in the neuroscientific study of distributed, de-centralized cognition. It is also at the heart of an emerging philosophical and psychological framework know as Situated Action theory. The combined momentum of these varied but converging studies will impact strongly upon our daily ideas and images of mind, rationality and reason. Practical wisdom—the ability to act appropriately, in real-time, real-world situations—will displace abstract, rule-invoking reason as the paradigm case of rational intelligent behavior. The barriers between perception, cognition, and action will be eroded and the vestigial Cartesian divide between mind, body, and world will be openly called into question. The very idea of human agents as INFORMAVORES (detectors and consumers of environmentally specified information) will be seen as a misleading half-truth: a dangerous invitation to de-temporalize and over-intellectualize the function of neural control systems.

For in the natural context of body and world, the ways brains solve problems is itself fundamentally altered. This is not a deep philosophical fact (though it has profound consequences). It is a matter of practicality. Jim Nevins, who works on computer-controlled assembly, has a nice example. Faced with the problem of how to get a computer-controlled machine to assemble tight-fitting components, one solution is to exploit multiple feedback loops. These could tell the computer if it has failed to find a fit and allow it to try again in a slightly different orientation. This is, if you like, the solution by Pure Thought. The solution by Embodied Thought is quite different. Just mount the assembler arms on rubber joints, allowing them to give along to spatial axes. Once this is done, the computer can dispense with the fine-grained feedback loops, as the parts jiggle and slide into place "just as if millions of tiny feedback adjustments to a rigid system were being continuously computed" (quoted in Mitchie and Johnson 1984:95).

It is a simple example, and many more complex and interesting demonstrations exist. But it makes a crucial point. Treating cognition as symbolic problem solving invites us to abstract away from the very body and world in which our brains evolved to guide us. Might it not be more fruitful to think of brains as controllers for embodied activity? That small shift in perspective has large implications for how we construct a science of the mind. It demands, in fact, nothing less than a sweeping reform in our whole way of thinking about intelligent behavior.

It requires us to abandon the idea (common since Descartes!) of the mental as a distinct realm from the realm of the body. To abandon the idea of a neat dividing line between perception, cognition, and action. To abandon the idea of an executive center where the brain carries out high-level reasoning. And most of all to abandon the research methods that artificially divorce thought from embodied action-taking. What emerges is nothing less than a new science of the mind: a science which, to be sure, builds on the fruits of three decades of co-operative research. But a science whose tools and models are surprisingly different. A cognitive science of the embodied mind. Such a science is still in its infancy, and the full power and scope of the new vision remain to be determined. But the issues raised will, I believe, shape the agenda of the next decade of research into mind and its place in nature.

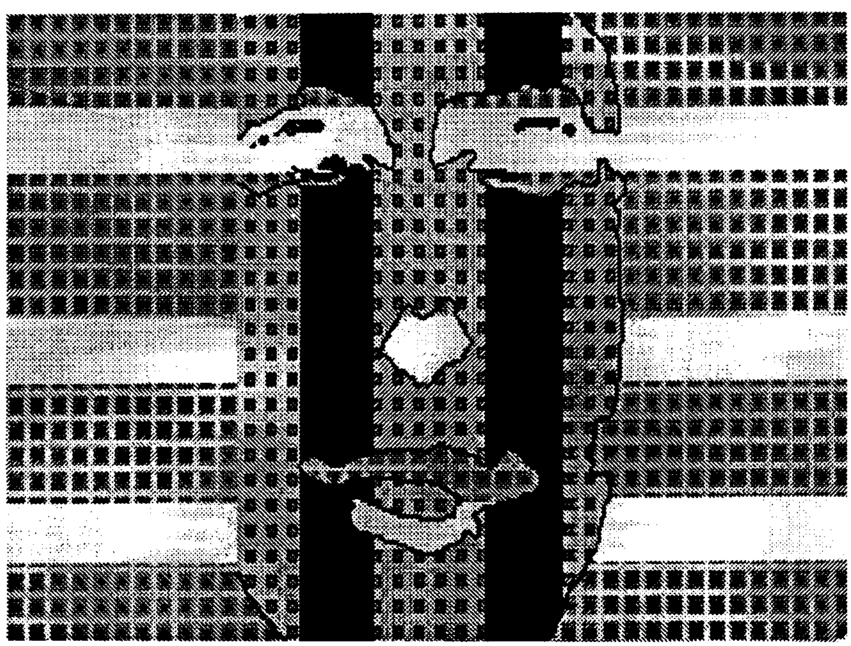
### References


Beer, R., Ritzmann, R., and McKenna, T., eds. (1993) *Biological Neural Networks In Invertebrate Neuroethology and Robotics*. London: Academic Press.

Clark, A. (1989) *Microcognition: Philosophy, Cognitive Science and Parallel Distributed Processing*. Cambridge: MIT Press.

Clark, A. (1993) *Associative Engines: Connectionism, Concepts and Representational Change*. Cambridge: MIT Press.

Mitchie, D. and Johnson, R. (1984) *The Creative Computer*. U.K.: Penguin.

*(Computerized Image by Michael Keough)*

# Sentence Processing Disorders in Aphasia: Theory and Treatment[1]

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Imagine that you have encountered Figure 1 in a children's book, illustrating a barnyard fight between "Jean" and "Angela". Which is which? You discover the answer when you read the sentence, "Angela kicked Jean." It's the syntax that provides the clue; the verb and the configuration of phrases around it identifies Angela as agent of the kicking action (hence, the horse) and Jean as the undergoer (the cow). I'll call this capacity to assign thematic roles (agent; undergoer) to referential elements based on their syntactic functions (subject; direct object), "syntactic comprehension."

In individuals who suffer stroke or other damage to the language-dominant, left side of the brain, the capacity for syntactic comprehension is reduced or eliminated. This disorder is especially prevalent among so-called agrammatic Broca's aphasics, who are known primarily for their difficulties in *producing* speech, in particular, grammatical morphemes (function words and bound affixes; see below). The finding in the mid 1970's that the same patients who show this agrammatic speech pattern also show impaired syntactic comprehension encouraged cognitive scientists to try to explain the parallels with reference to models of normal sentence processing.

## Analysis of Impaired Syntactic Comprehension

The syntactic comprehension deficit is revealed by sentence enactment or sentence-picture matching tasks that manipulate semantic reversibility and syntactic complexity as crossed factors. The general finding is accurate performance on nonreversible sentences (e.g., (1), (2)) irrespective of complexity, and errors on reversible sentences, especially those like (4) and (5) that violate canonical mapping rules (S-V-O —> Agent-Action-Undergoer).

(1) The horse kicked in the fence.
(2) The fence was kicked in by the horse.
(3) The horse kicked the cow.
(4) The cow was kicked by the horse.
(5) The cow that the horse kicked was brown.

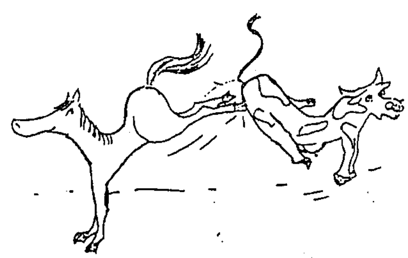

*Figure 1. "The horse kicked the cow."*

Most theoretical accounts of normal syntactic comprehension include the following steps:

Step 1. Parse the input string for the verb and the major syntactic phrases. In the sentence *Angela kicked Jean*, the verb is *kick*; *Angela* is subject of the sentence; *Jean* is direct object. For the passive voice sentence, *Jean was kicked by Angela*, the parse would also deliver the information that the verb is inflected for past participle and that there is a by-phrase whose object is *Angela*.

Step 2. Look up the lexical entry for the verb to see what grammatical roles it assigns. Kick assigns to the grammatical subject the role of agent and to the direct object the role of undergoer. Other verbs assign roles differently. Consider this pair of sentences: *Angela gives a kick to Jean*; and *Jean receives a kick from Angela*. For "give", the grammatical subject is the agent and source of the exchange; for "receive" the grammatical subject is the recipient. Thus, part of knowing the meaning of a verb is knowing what roles it assigns and how.

Step 3. Interpret the relevant syntactic phrases in accordance with their assigned roles. Another way of saying this is "map syntactic phrases onto thematic roles." For *Angela kicked Jean*, the mapping goes like this: Angela–subject–agent of kick–the one whose foot makes contact with the body of the other. In the case of complex sentences like passives, mapping may involve mentally tracking the elements that have moved out of their underlying, deep structure positions. For *Jean is kicked by Angela*, Jean is the subject of the passive–fronted direct object–undergoer of kick–one whose body is contacted by the foot of the other.

Let us now consider where in this sequence of steps the agrammatics' syntactic comprehension deficit resides.

Step 1. Until recently, the preferred account has been that the problem arose at the parsing stage, that agrammatics could not achieve an adequate parse of the sentence either because their syntactic knowledge was compromised or because of difficulties in processing grammatical morphemes. Such accounts were seriously challenged by work carried out in my laboratory that showed that patients with even severe syntactic comprehension deficits were surprisingly accurate in judging the grammatical well-formedness of spoken sentences (Linebarger, Schwartz, and Saffran 1983). The fact that such patients are able to detect grammatical violations that turn on constituent phrase structure or grammatical morphology indicates that they are sensitive to the rules and vocabulary utilized in parsing and that their input systems are realizing the structural analysis generally attributed to the parsing stage.

The finding that asyntactic comprehenders can perform grammaticality judgments has been replicated many times, in many different languages. Moreover, the use of methods that examine sentence processing in real time have confirmed that the syntactic capabilities that

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[1] This work is supported by NIH/NIDCD grant #DC01825-03.

these patients manifest in the grammaticality judgment task are exploited as well in the ordinary business of processing sentences. At the same time, these on-line studies have produced evidence that agrammatics may not achieve fast, automatic access to words or syntactic information during the parsing stage (e.g., Friederici et al. 1992; Haarman and Kolk 1991; Swinney, Zurif, and Nicol 1989). The consequence of slowed or desynchronized parsing for sentence comprehension is just beginning to be explored.

Step 2. Agrammatic Broca's aphasics have good knowledge of the meanings of nouns and verbs. But there is some evidence to suggest that their knowledge of the thematic assignments of at least certain verbs may be weak. Byng (1988) investigated the ability of two Broca's aphasics to distinguish between thematically related verbs, such as give and take, by pointing to the corresponding action in a split-screen video. No sentence contexts were provided. Both patients were significantly impaired on the thematically related pairs relative to other types of verb contrasts. Subsequent studies have confirmed that defective verb knowledge may be a contributing factor for some, though certainly not all, asyntactic comprehenders.

Step 3. The evidence from grammaticality judgments that was used to argue against the impaired parsing account has been used to argue in favor of a syntax-semantics mapping deficit (Linebarger 1990). In those few conditions where agrammatic patients performed poorly, the grammatical violations turned on faulty agreement between two constituents with respect to some semantic feature like gender, number, tense, or aspect. It was suggested that the agrammatic comprehension system breaks down at the point where the products of the structural parse (step #1) are mapped onto representations at deep structure that reflect meaning relations. This affects, among other things, thematic role mapping. The less "transparent" the mapping (i.e., the more removed the surface constituents from the deep structure positions over which mapping is defined) the less likely it is that the vulnerable mapping operations will be carried out successfully (Schwartz et al. 1987).

There are other reasons why step #3 in the syntactic comprehension process might be compromised in agrammatic patients. Because it requires integration of the structural products of parsing with thematic information supplied by the verb, it would be sensitive to a number of deficiencies in the Broca's language system, including timing alterations at the parsing stage; reduced computational resources (e.g., Caplan and Hildebrandt 1988; Frazier and Friederici 1991); or limitations in working memory (Miyake, Carpenter, and Just 1994).

To summarize, the model-driven analysis of impaired syntactic comprehension has yielded important insights. Contrary to earlier belief, it appears that the rules and vocabulary on which parsing depends remains surprisingly well preserved in "asyntactic" comprehenders, while the weak link seems to reside in the mapping of parsed constituents onto representations of meaning relations, including thematic roles. What remain to be disentangled are the relative contributions of faulty processing at the mapping stage, slowed retrieval at the parsing stage, and deficiencies in processing resources utilized at both stages.

## Impaired Grammatical Production

Agrammatic production has been analyzed and quantified through the use of story narratives (Saffran, Berndt, and Schwartz 1989). Figure 2 shows the Cinderella narrative obtained from one moderate agrammatic aphasic, 7 years post onset.

The hallmark of agrammatic speech is the simplification and fragmentation of morphosyntactic structure. The function words that glue words into phrases and that interrelate phrases and clauses are largely absent from agrammatic speech. Bound morphemes (i.e., verb and noun inflections) are affected as well, but how and to what degree varies across languages (Bates, Wulfeck ,and MacWhinney 1991). And the simplification of syntactic structure goes beyond this prob-

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a mother/... three kids/... bad mother/one kid beautiful/... rich/Italian/... mother/... stepmother/... talk about Cinderella/Cinderella/clean my house/... you Cinderella/close the door/ ... Cinderella like jail/... mother... three kids/... I love mother/... Cinderella walk ball/... people ball/... rich rich people/... man and Cinderella dance dance dance party/... one/... dance dance dance/... dance every time/... ball beautiful people/... people watched Cinderella/... Cinderella ... beautiful clothes ... and garments/... twelve o'clock night/ Cinderella/oh no/oh no I'm sorry/I'm sorry people/I love you baby/... walk walk/tumble/... one shoe bye-bye/... Cinderella ... pumpkin cab/... oh shoe/oh please/oh well/walk pumpkin car/... walk ... time tone/... Cinderella car and ... old clothes/... Cinderella/no me same/Cinder home/cry cry cry/... stepmother/what the hell and ... clean your house/... wash dishes and ... pans and pans and ... laundry/... oh well tomorrow ... we'll see/... tomorrow next time/man sad/Cinderella/where Cinderella/where/... woman name Cinderella/people what/no no no I'm sorry/... who who Cinderella/no/man sad sad sad/... walk/walk walk walk/... mother house/man maybe mile/maybe Michael/... man walk/... house Cinderella/no no no sorry/Cinderella here/oh who who/no no no I'm sorry no/... Cinderella and animals love/... Cinderella sad/maybe ... two days after/man walk Cinderella mother house/... three stepsisters and mother/... man/Cinderella here/... Jesus Christ/... man/... I love you Cinderella/... happy go lucky

*Figure 2. Recounting of the Cinderella story by C.B., an agrammatic aphasic seven years post onset.*

Following Saffran, Berndt, and Schwartz (1989), slashes demarcate utterances and "..." indicates deletion of non-narrative words, such as stereotypic phrases, asides, and repaired or amended speech.

lem with free and bound function morphemes. For example, the noun phrases produced by agrammatics are marked not only by the omission of determiners (a type of grammatical morpheme) but also by paucity of noun and adjective modifiers (Menn and Obler 1990). Verb phrases may contain direct objects, but direct-indirect object combinations are rare, as are direct object-prepositional phrase combinations.

Cognitive scientists who study agrammatic speech generally agree that the morphosyntactic simplification reflects breakdown at a relatively late stage in the sentence planning process, e.g., in the retrieval of syntactic planning frames and/or the positional level representation built on these frames (see Garrett 1980; Schwartz 1987). However, my colleagues and I have argued that earlier (deeper) stages of production are also compromised. For one things, main verbs are markedly under-represented in agrammatic speech. When normal speakers recount the story of Cinderella, they produce on average equal numbers of nouns and verbs. Agrammatics, in contrast, produce three times as many nouns as verbs. In the narrative shown in Figure 3, nouns outnumber verbs by a ratio of 2.3- to-1.

Another indication of early-stage production problems is the presence of thematic role reversals in agrammatics' picture descriptions. Such errors arise only under particular testing conditions, i.e., when the entities depicted in the scene are closely matched in conceptual saliency (e.g., both animate or both inanimate) and where there is the potential to describe the event from either perspective (e.g., *x* leads *y* vs. *y* follows *x*; *x* gives to *y* vs. *y* receives from *x*). These testing conditions neutralize the conceptually-based ordering tendencies that are operative in the speech of normals and, as it turns out, agrammatics as well (e.g., the tendency to mention entities high in conceptual salience early in the sentence). This, in turn, forces reliance on verb-stated mapping rules, as well as general syntactic rules that encode generalizations like "The first choice for subject is the agent; next the undergoer; next the instrument...". That agrammatics are vulnerable to syntactic role reversals under these conditions suggests that structural syntactic influence on thematic role assignment is weak in production, as it is in comprehension.

Picture description tests that do not meet the conceptual conditions just mentioned do not elicit thematic role reversals (e.g., Bates et al. 1988). Nor are such reversals generally apparent in agrammatics' conversational or narrative discourse (see Figure 2). However, it is quite likely that patients' difficulty in bringing mapping requirements to bear in sentence formulation manifests in ways other than subject-object reversal, and that herein lies the true functional significance of the mapping deficit. For one thing, mapping information is crucial in coordinating verb selection with noun phrase ordering. Failure to bring this information to bear in a timely and effective manner probably contributes to verb omissions. Also, the more complex mapping requirements of sentences with more than two arguments (e.g., sentences like "x is giving y to z") may help explain the scarcity of these structures in agrammatic speech.

### Treatment Implications

In the preceding sections I have argued that syntactically-based mapping is implicated in both the expressive and receptive disorders of agrammatic aphasics. Based on this evidence, researchers at Moss and elsewhere have been exploring treatment programs aimed at remediating the mapping deficit. This represents a radical departure from routine clinical treatment of agrammatism. Clinicians, understandably, concentrate on the morphosyntactic production deficit, guiding the patient through repetition and picture description drills designed to produce longer and more grammatical strings. Mapping-based treatments, in contrast, use comprehension or metalinguistic judgment tasks to focus the patient's attention on verb-noun relations in simple and complex sentences. Training to produce sentences, while it may form a part of the overall mapping treatment, is generally de-emphasized. Nevertheless, the expectation is that mapping training will impact sentence production, resulting in the greater production of verbs and more complex verb-argument structures, and a reduction in the number of single word utterances.

These predictions have been tested in a number of case studies (Byng 1988; Jones 1986; Nickels, Byng, and Black 1991), with generally encouraging results. At the Moss Rehabilitation Research Institute, a team of speech pathologists and cognitive scientists is working to develop and test a semi-standardized mapping therapy program that will have broader applicability across patients and settings.

Our mapping therapy protocol employs a metalinguistic judgment task which requires the subject to identify the verb, agent, and undergoer in sentences which they read aloud and have read to them. The goal is to focus attention on the who's-doing-what-to-whom message content, as well as to provide structured practice in picking out the relevant elements in sentences with varied syntax. The mechanism of training is immediate, corrective feedback. The subject responds to probe questions[2] by marking the relevant elements directly on the written sentence, then checks her markings against a standard. There is no attempt to teach rules. In our many studies looking at how agrammatics detect violations of grammatical and semantic well-formedness, we have become convinced that most patients possess the lexical and linguistic knowledge required for mapping but do not reliably bring this information to bear in comprehending or speaking sentences. The feedback they receive in mapping therapy is designed to tap this latent knowledge and make it explicit. In addition, the stimulus materials are constructed in such a way as to discourage reliance on non-syntactic cues (e.g., first noun as agent; noun to left of verb as agent) which often interferes with or substitutes for algorithmically-based mapping.

In a preliminary study with 8 patients (2 of whom failed to complete the program for reasons of health) acquisition and generalization profiles were found to be highly individualistic. The "purer" agrammatic subjects—those with relatively preserved lexical processing and good syntactic knowledge as measured by grammaticality judgments — made good

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[2] On each trial, the subject is asked first to circle the main verb. For example, given the sentence, "The nurse called the tired patient," he or she would circle *called*. On some trials, this is followed by a query for the agent: "which one is doing the calling?", to which the subject responds by underlining *nurse*. On others, it is followed by a query for the undergoer: "who or what is she calling?", to which the subject responds by underlining *patient*. Before any training begins, the subject is introduced to the probe questions, and, if necessary, trained to decipher them, through the use of picture materials.

progress in training, showing both material-specific learning and carry-over to untrained verb-argument relations and to more complex grammatical structures. Patients with more severe and more complicated aphasias had a harder time getting through the training task and showed variable generalization patterns.

The measure of success of mapping therapy is not how well subjects perform the training task but rather the extent of carry-over to comprehension and production tasks. Our subjects showed strong and consistent improvement in a variety of production measures. As predicted, this improvement was greatest on structural measures (e.g., number of words in sentences; proportion of verbs) and less on morphological measures (e.g., proportion of grammatical morphemes). Sentence comprehension showed predicted gains as well, though less robustly.

## The Modular Treatment of Aphasia

Our mapping therapy protocol was designed to function as a treatment module. By this, I mean a semi-standardized rehabilitation program that targets a linguistic skill that has proven to be defective on model-driven analysis. My colleagues and I have outlined a modular treatment approach to agrammatism and other aphasic disorders whereby combinations of modular treatments are administered consecutively or concurrently to address the multifaceted nature of aphasic syndromes (Schwartz and Whyte 1992; Schwartz et al. 1994).

Our experience with agrammatic patient G.R. demonstrates the need for a modular approach. This patient, 7 years post onset, experienced some amelioration of his very severe grammatical production disorder after taking part in our mapping therapy study. But he continued to be hampered by difficulty in retrieving verbs, in both single word and sentence production tasks. With speech pathologist Ruth Fink and others, we carried out a treatment study which compared a repetition priming technique for facilitating verb retrieval with a technique that employs cueing and modeling in the context of mapping-type probe questions. The second of these two training tasks proved more effective in inducing acquisition of the small set of training verbs and carry-over to a picture description task with untrained verbs. We are currently working on elaborating this training technique into a treatment module for verb retrieval. But the point here is to demonstrate the cumulative benefits of treatments that target specific deficits.

Figure 3 illustrates the changes in G.R.'s picture description responses following mapping therapy (24 sessions) and the verb treatment programs (41 sessions). Table 1 quantifies the changes on selected production measures. G.R.'s production of verbs remained stable after mapping therapy (although the other syntactic measures did improve) but increased substantially following the verb treatments. This improvement was stable over a 10 week follow-up interval. Since this study was not designed as a test of the modular approach, we did not control for the many nonspecific treatment effects that might have influenced G.R.'s performance. However, it is worth noting that the seven years of continuous speech/language therapy that he engaged in following his stroke and preceding his participation in our studies had effected little change in his profound verb and sentence production problems.

## Conclusion

The modular approach to treatment is necessitated by the multi-faceted character of aphasic syndromes. None of the linguistic deficits I have touched on in the article is necessarily present in every agrammatic. Some agrammatics show normal syntactic comprehension; some exhibit the morphosyntactic deficit but not the mapping deficit; others show the reverse pattern. Moreover, it is not just agrammatic Broca's aphasics who are subject to these deficits. For example, there have been reports of aphasics of the fluent, Wernicke type who also have impaired syntactic comprehension; or impaired thematic role mapping; or specific problems producing verbs and verb morphology. *It is the potential for dissociation among these component deficits and the fact that they relate to basic processes within normal sentence processing models, that makes them candidates for modular treatments.*

The definition of the component deficits in agrammatism, and hence the skills to be targeted for modular treatment, is the

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| | Pre Mapping (1/2/90) | Post Mapping (5/11/90) | Post Verb Studies (12/7/90) |
|---|---|---|---|
| Target | The boy is sleeping in the bed. | | |
| Pre M | Sleep...boy...bed... | | |
| Post M | The man is sleeping. | | |
| Post V | The boy is sleeping. | | |
| Target | The girl is giving flowers to the teacher. | | |
| Pre M | Girl and woman...flowers... | | |
| Post M | The...girls is washing...daisies. | | |
| Post V | The girl is...giving the papsies [poppies] to the teacher. | | |
| Target | The rock is falling on the boy. | | |
| Pre M | Rock... | | |
| Post M | The...the rock is small big...big... | | |
| Post V | The rock is...putting on the man. | | |
| Target | The ball is hitting the boy in the head. | | |
| Pre M | Baseball hit... | | |
| Post M | The baseball is...ah no... | | |

*Figure 3. Examples of G.R.'s Picture Description Performance at Three Points in Time: Pre and Post Mapping Therapy (M) and Post Verb Studies (V)*

G.R. took 24 sessions to complete mapping therapy and 41 sessions to complete verb studies.

*Table 1. Pre and Post Therapy Production Measures on a 20-item Picture Description Task for Subject G.R. (Reproduced from Fink et al. , 1993.)*

| | Pre Mapping Therapy (1/2/90) | Post Mapping Therapy (5/11/90) | Post Verb Studies Therapy (12/7/90) |
|---|---|---|---|
| % of words in 'sentences'* | 52% | 88% | 97% |
| Number of 'sentences'* (max = 20) | 10 | 16 | 19 |
| % of syntactically well-formed sentences* | 30% | 44% | 74% |
| Number of non-copula verbs (max = 18) | 10 | 11 | 18 |
| Number of acceptable verbs (max = 18) | 9 | 9 | 14 |

* Based on Saffran, Berndt, and Schwartz (1989).

## Aphasia (cont.)

subject of controversy. The analysis presented here generates a particular set of candidates: morphosyntactic production; retrieval of verbs and verb- stated mapping rules; mapping between thematic roles and syntactic constituents. Many aphasiologists would take issue with this list. Each of these deficits is subject to further decomposition in terms of observed dissociations (e.g., problems producing one class of grammatical morphemes but not others) or in terms of the levels and processing mechanisms implicated. Any listing of candidates for targeted intervention must take into account the theoretical and practical difficulties involved in conducting this more fine-grained dissection of symptoms and the questionable relevance *for rehabilitation* purposes of doing so. I advocate using the theoretical model to anticipate the various ways in which a particular deficit might arise and then designing treatment modules to be maximally effective even when the precise cause is unknown or unknowable. In this way we might be able to arrive at a rehabilitation strategy that is both rational and practical.

### References


Bates, E.A., Friederici, A.D., Wulfect, B.B., and Juarez, L.A. (1988) On the preservation of word order in aphasia: Cross-linguistic evidence. *Brain and Language* 33:323-364.

Bates, E., Wulfeck, B., and MacWhinney, B. (1991) Cross-linguistic research in aphasia: An overview. *Brain and Language* 41:123-148.

Byng, S. (1988) Sentence processing deficits: Theory and therapy. *Cognitive Neuropsychology* 5:629-676.

Caplan, D. and Hildebrandt, N. (1988) *Disorders of Syntactic Comprehension.* Cambridge, MA: MIT Bradford.

Fink, R.B., Martin, N., Schwartz, M.F., Saffran, E.M., and Myers, J.L. (1993) Facilitation of verb retrieval skills in aphasia: A comparison of two approaches. *Clinical Aphasiology* 21:263-275.

Frazier, L. and Friederici, A.D. (1991) On deriving the properties of agrammatic comprehension. *Brain and Language* 40:51-66.

Friederici, A.D., Wessel, J.M.I., Emmorey, K., and Bellugi, U. (1992) Sensitivity to inflectional morphology in aphasia: A real-time processing perspective. *Brain and Language* 43:747-763.

Garrett, M.F. (1980) Levels of processing in sentence production. In B. Butterworth (Ed.), *Language Production: Vol. 1.* London: Academic Press.

Jones, E.V. (1986) Building the foundations for sentence production in a non-fluent aphasic. *British Journal of Disorders of Communication* 21:63-82.

Haarman, H.J. and Kolk, H.H.J. (1991) Syntactic priming in Broca's aphasics: Evidence for slow activation. *Aphasiology* 5:1-36.

Linebarger, M.C. (1990) Neuropsycholgy of sentence parsing. In A. Caramazza (Ed.) *Cognitive Neuropsychology and Neurolinguistics: Advances in Models of Cognitive Function and Impairment.* Hillsdale, NJ: Erlbaum.

Linebarger, M.C., Schwartz, M.F., and Saffran, E.M. (1983) Sensitivity to grammatical structure in so-called agrammatic aphasics. *Cognition* 13:361-394.

Menn, L. and Obler, L.K. (1990) Cross-Language data and theories of agrammatism. In L. Menn and L.K. Obler (Eds.), *Agrammatic Aphasia: A Cross-Language Narrative Sourcebook: Vol. 2.* Amsterdam: John Benjamins.

Miyake, A., Carpenter, P.A., and Just, M.A. (1994) A capacity approach to syntactic comprehension disorders: Making normal adults perform like aphasics. *Cognitive Neuropsychology* 11:671-717.


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# Lehigh Events

3 March 1995
"Turing Test Considered Harmful"
Ken Ford
Institute for Human and Machine Cognition
University of West Florida

Half a century ago, Alan Turing half-seriously proposed that the goal of AI should be success in a certain "imitation game," designed to make a computer suitably indistinguishable from a human. Now called the Turing Test, this is still often cited as the ultimate goal or driving vision of AI in everything from AI textbooks to philosophical attacks on the subject. Turing was undoubtedly a genius, but the Turing Test was a mistake. It is now an embarrassment, and the time has come to relegate it into a historical curiosity, and consciously embrace the newer goals which have, in fact, characterised most AI work since the subject reached maturity.

6 April 1995
"Lexical and Conceptual Representation in the Bilingual Mind"
Robert Dufour
Department of Psychology
Swarthmore College

Recent studies of language representation in bilinguals indicate that the two languages have distinct lexical representations. However, words in the two languages access shared conceptual representations. Dr. Dufour presented data supporting this linguistic architecture and discussed how individual differences in cognitive abilities, mainly working memory span and text comprehension, affect the learning of a second language and the processing of two languages.

20 April 1995
"Heuristics and Biases in the 'Eye-Balling' of Data: The Effects of Context on Intuitive Correlation Assessment"
Wesley Hutchinson
The Wharton School
University of Pennyslvania

For a wide variety of real-world decisions, people must examine numerical tables and intuitively assess the correlations that exist among meaningful variables. The normative properties of correlation coefficients suggest that their decisions should be unaffected by perceptual factors (such as changes in the relative locations of the rows and columns of the tables), semantic factors (such as the referents of the numbers), or arithmetic transformations that do not alter the correlational structure of the tables (such as adding a constant or multiplying by a constant). Dr. Hutchinson described four experiments in which judgments based on perceived correlations violate these normative properties. In each experimental condition, the results were most consistent with one of two types of heuristics (exemplar-based or proximity-based). Contextual factors determined which type was more likely. Other plausible heuristics (including prototype-based, recency-based, and trend detection heuristics) were either rejected by the results or received only weak support.

## Cognitive Brown Bag Series

29 March 1995
"Order and Disorder in Sentence Production: The Case of Heavy-NP Shift"
Padraig G. O'Seaghdha
Department of Psychology
Lehigh University

Heavy-NP shift is a well-known but little explained phenomenon whereby a long or "heavy" noun phrase (NP) is displaced to the right of its usual immediately post-verbal position. For example in the sentence "Snowball had found in the basement an old green tablecloth of Mrs. Jones's" the NP is moved to the right of the PP "in the basement." In a collaboration with Lynne Stallings and Maryellen MacDonald of USC, the speaker showed (a) that the Heavy-NP shift phenomenon occurs in an on-line sentence construction task, and (b) that it is influenced by the prior shifting frequency of the main verb in the sentence. Furthermore, decision latencies are slower in conditions where NP-shift is more likely, suggesting that competition between the alternative sentence structures precedes the decision to shift or not to shift.

12 April 1995
"Feasts, Floods, and Full Tanks of Gas: Categories and Metaphors"
Matthew S. McGlone
Department of Psychology
Lafayette College

How do people understand metaphors such as "His lecture was a 3-course meal?" Lakoff has proposed that metaphors are understood as instantiations of metaphorical correspondences between abstract and concrete domains (e.g., IDEAS ARE FOOD). Three experiments were reported investigating this claim. The results suggest that reference to a conceptual metaphor is not the modal strategy that people use when paraphrasing metaphors (Experiment 1), rating the similarity between metaphors (Experiment 2), or recalling metaphors (Experiment 3). In each of these situations, people refer primarily to the stereotypical properties (e.g., large quantity) of the vehicle concept (e.g., 3-course meal) that may plausibly be attributed to the topic concept (e.g., his lecture). The results of these experiments are consistent with the view that metaphors are understood as attributive categorizations.

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# Meetings of Interest

### Cognitive Science 1995

This year's conference of the Cognitive Science Society will be held in Pittsburgh, July 22-25, at the William Pitt Union at the University of Pittsburgh (co-hosted by by Carnegie Mellon University). For more information, view the WWW document:
http://www.pitt.edu/~cogsci95
or send electronic mail to Alan Lesgold:
alan@lrdc4.lrdc.pitt.edu
or write:
Cog Sci 1995 Meeting
c/o Cassandra Stanley, LRDC
University of Pittsburgh
Pittsburgh, PA 15260
or phone Ms. Stanley at:
(412) 624-7046

### Intelligence in Neural and Biological Systems

The aim of this First International IEEE Symposium (to be held May 29-31,1995, at the Hyatt Hotel, Dulles Airport, VA) are evolutionary and the intelligence processes in both artificial and biological systems and the interaction between them. Topics include evolutionionary computing, biotechnology, genetic algorithms, language understanding, learning, and neuroscience. For more information, phone:
(607) 777-2165 or (607) 771-4033
or send electronic mail to:
bourbaki@bingsuns.cc.binghamton.edu

### Multiagent Systems

The First International Conference on Multiagent Systems will be held June 12-14, in San Francisco. For more information, contact:
Victor R. Lesser
Computer and Information Science Department
University of Massachusetts
Amherst, MA 01003
or phone:
(413) 545-1322
or send electronic mail to:
lesser@cs.umass.edu

### Machine Learning

The Twelfth International Conference on Machine Learning will take place July 9-12, at Tahoe City, CA. For more information, contact:
Jeffrey Schlimmer
Washington State University
School of Electrical Engineering and Computer Science
Pullman, WA 99164-2752
or send electronic mail to:
schlimmer@eecs.wsu.edu

### World Congress on Neural Networks

The International Neural Networks Society will host this year's congress July 17-21, in Washington, D.C. For more information, contact:
Melissa Bishop
875 Kings Highway, Suite 200
Woodbury, NJ 08096-3172
or phone:
(609) 845-1720
or fax:
(609) 853-0411

### IJCAI

The 14th International Joint Conference on Artificial Intelligence is planned for August 20-25, in Montreal. For more information, contact:
AAAI
445 Burgess Drive
Menlo Park, CA 94025
or phone:
(415) 328-3123
or send electronic mail to:
ijcai@aaai.org

### Boston University Conference on Language Development

The 20th Annual conference will be held November 3-5. The keynote speaker will be Lila Gleitman of the University of Pennsylvania. For more information, phone:
(617) 353-3085
or send electronic mail to:
langconf@louis-xiv.bu.edu

**"Make it idiot-proof, and someone will make a better idiot."**

### Computing and Philosophy

The Tenth Annual Conference on Computing and Philosophy will be held August 10-12 in Pittsburgh, PA. For more information, contact:
Marvin Croy, Program Chair
University of North Carolina
Department of Philosophy
Charlotte, NC 28223
or phone:
(704)-547-2161

### Artificial Intelligence in Education

The Seventh World Conference on Artificial Intelligence in Education will be held August 16-19, in Washington, D.C. For more information, contact:
AIED95
P.O. Box 2926
Charlottesville, VA 22902
or send electronic mail to:
aace@virginia.edu

### Neural Information Processing Systems: Natural and Synthetic

This year's NIPS foundation conference will take place Nov 27-Dec 2, at Denver and Vail, Colorado. For more information, send mail to:
NIPS*95
Dept. of Mathematical & Computer Sciences
Colorado School of Mines
Golden, CO 80401
or fax:
(303) 273-3875
or send electronic mail to:
nips95@mines.colorado.edu
or access the WWW home page at:
http://www.cs.cmu.edu:8001/afs/cs/project/cnbc/nips/NIPS.HTML

## Aphasia (cont.)

Nickels, L., Byng, S., and Black, M. (1991) Sentence processing deficits: A replication of therapy. *British Journal of Disorders of Communication* 26:175-199.

Saffran, E.M., Berndt, R.S., and Schwartz, M.F. (1989) The quantitative analysis of agrammatic production: Procedure and data. *Brain and Language* 37:440-479.

Schwartz, M.F. (1987) Patterns of speech production deficit within and across aphasia syndromes: Application of a psycholinguistic model. In M. Colheart, G. Satori, and R. Job (Eds.), *The Cognitive Neuropsychology of Language*. Hillsdale, NJ: Erlbaum.

Schwartz, M.F., Linebarger, M.C., Saffran, E.M., and Pate, D.S. (1987) Syntactic transparency and sentence interpretation in aphasia. *Language and Cognitive Processes* 2:85-113.

Schwartz, M.F., Saffran, E.M., Fink, R.B., Myers, J.L., and Martin, N. (1994) Mapping therapy: A treatment program for agrammatism. *Aphasiology* 8:19-54.

Schwartz, M.F. and Whyte, J. (1992) Methodological issues in aphasia treatment research: The big picture. In *Aphasia Treatment: Current Approaches and Research Opportunities*. N.I.D.C.D. Monograph-Vol. 2. Bethesda: N.I.H. Publication No. 93-3424.

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Swinney, D., Zurif, E., and Nicol, J. (1989) The effects of focal brain damage on sentence processing: An examination of the neurological organization of a mental module. *Journal of Cognitive Neuroscience* 1:25-37.

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